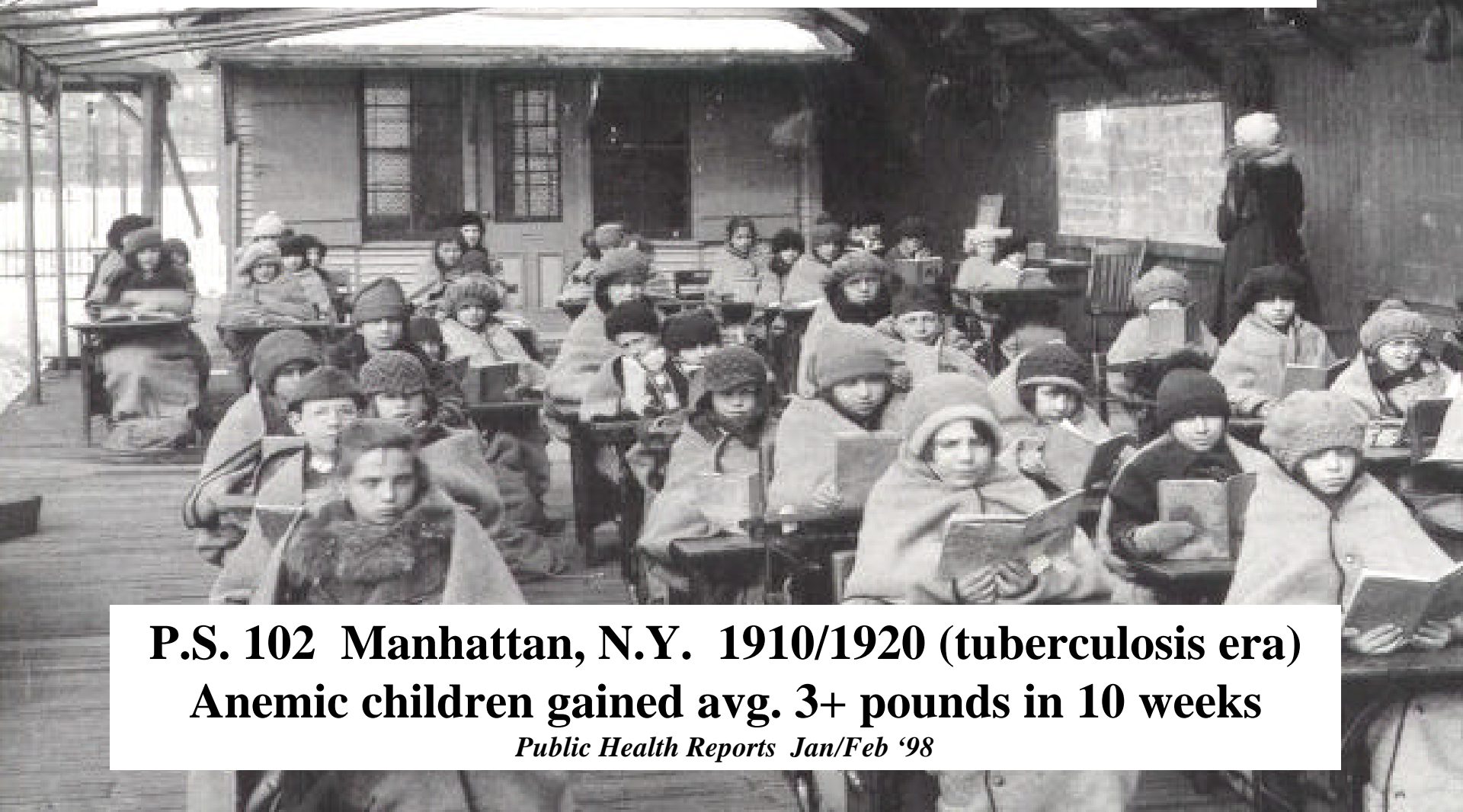




# **High Performance Schools** *A Vision for America's Future*

**Loren M. Belida, AIA**  
**The H.L.Turner Group Inc.**  
*Architects, Engineers, Building Scientists*  
*Concord, NH, USA*

# Is This a High Performance Learning Environment ?



**P.S. 102 Manhattan, N.Y. 1910/1920 (tuberculosis era)**  
**Anemic children gained avg. 3+ pounds in 10 weeks**

*Public Health Reports Jan/Feb '98*

# How Do We Know That Our Buildings Are 'Unhealthy' ?

GAO

United States General Accounting Office

Report to Congressional Requesters

February 1997

## SCHOOL FACILITIES

### Condition of America's Schools



# What's The Common Denominator ?

- *Asthma is the #1 disease affecting school children.*  
*American Lung Assoc.*
- *Nearly half of all teachers are afflicted with respiratory illnesses sometime in their career.*  
*Healthy Buildings '97*



# Staff/Community Input

## Top Ten Issues

#1 **Air Quality**

#2 Storage

#3 Academics

#4 **Lighting**

#5 Computer Technology

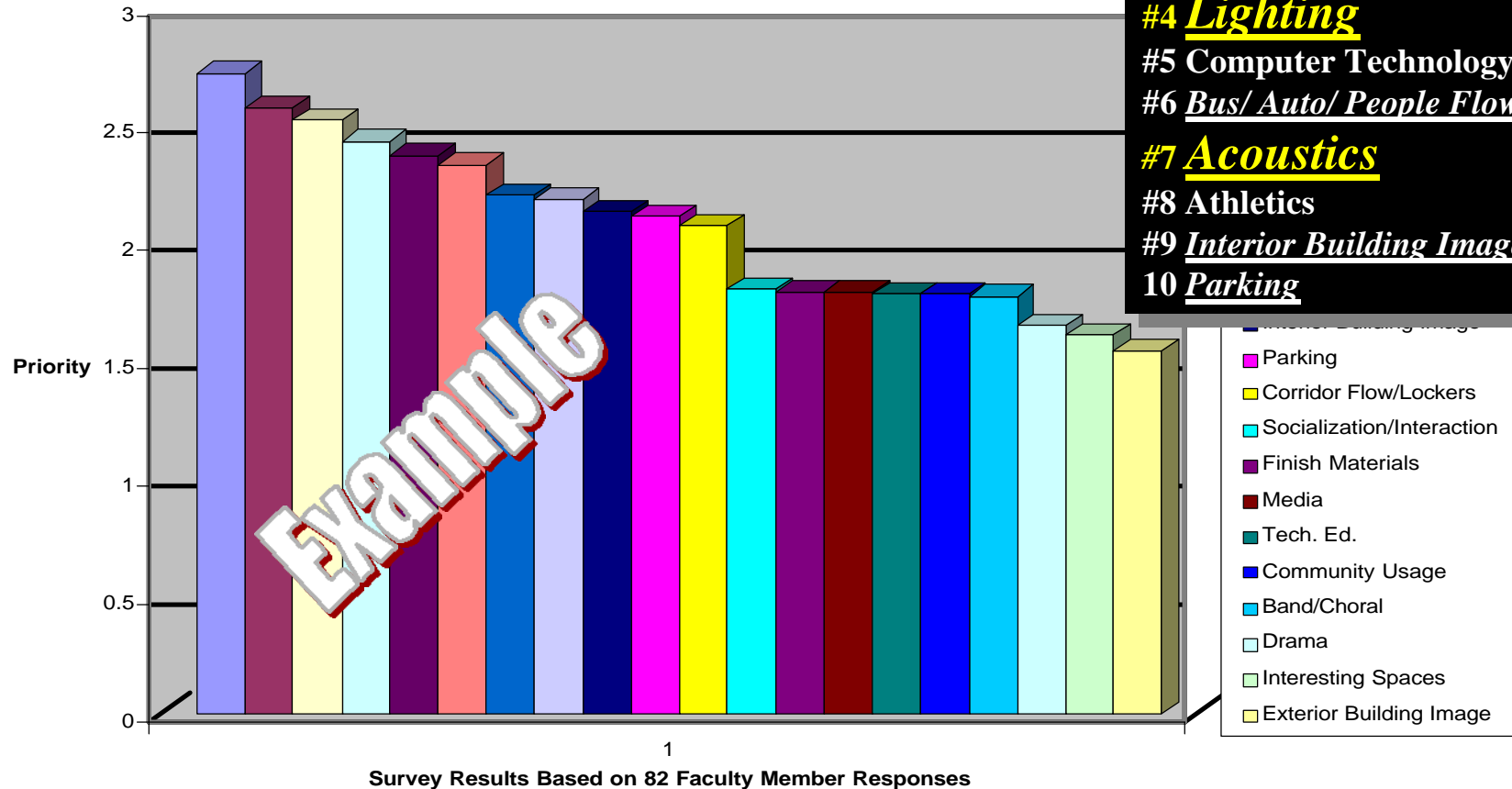
#6 **Bus/ Auto/ People Flow**

#7 **Acoustics**

#8 Athletics

#9 **Interior Building Image**

10 **Parking**

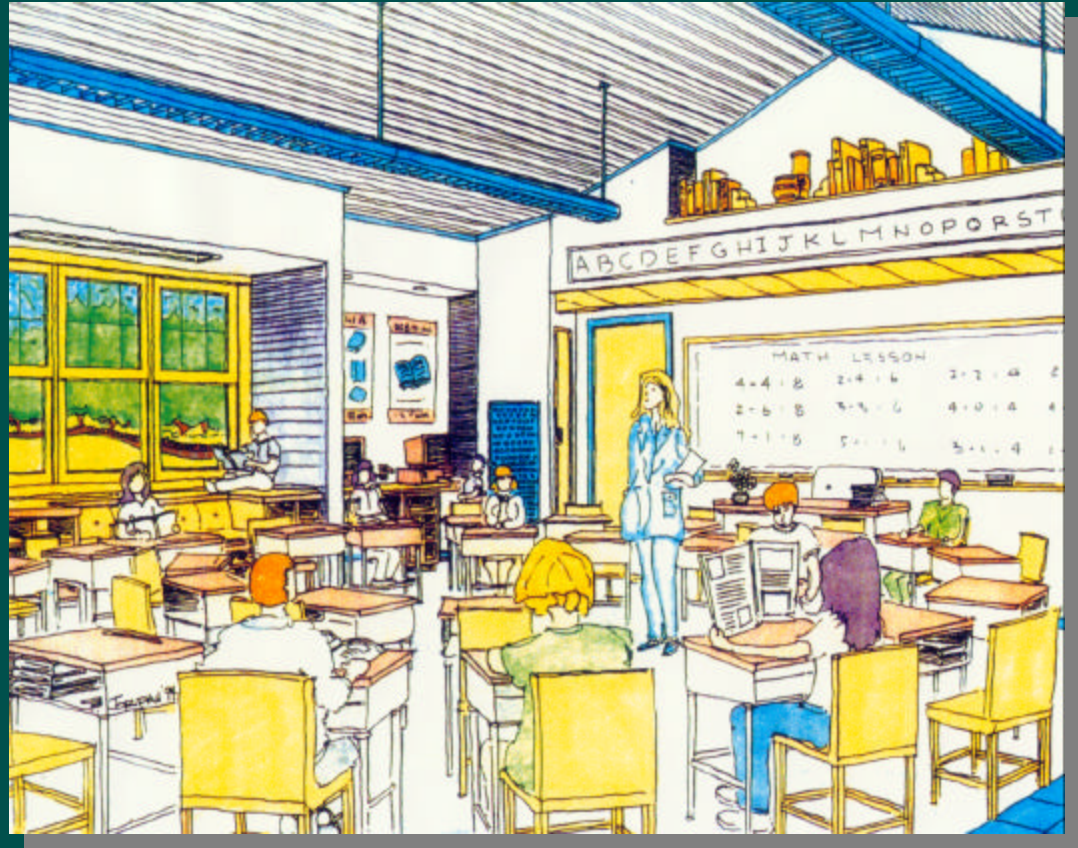




# *High Performance Schools ....*

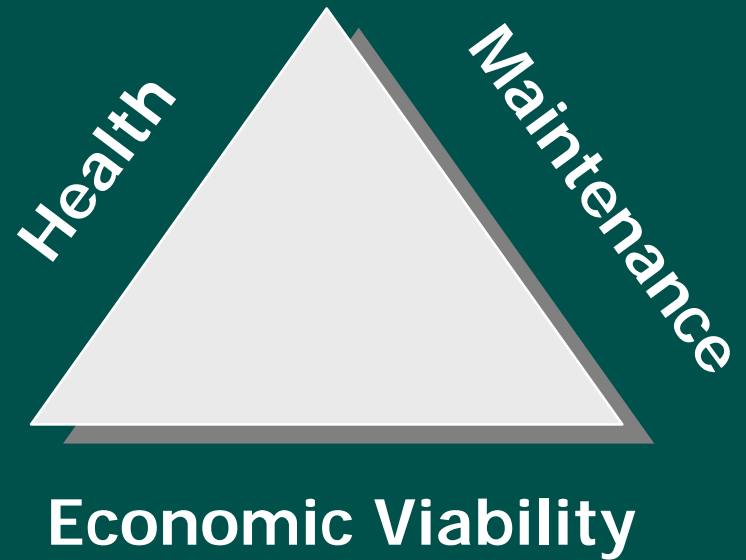
- Air Quality
- Lighting
- Acoustics
- Stimulation
- Community

*“Healthy Buildings”*



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Scientists ~ Concord NH USA

# Cause & Effect



*“It is impossible to do something better if it is not done differently”*

*Dr. Amar Bose ~ SBANE  
New Englander Award for Innovation*

# Planning for How Far Ahead ?

A) 5 years

B) 10 years

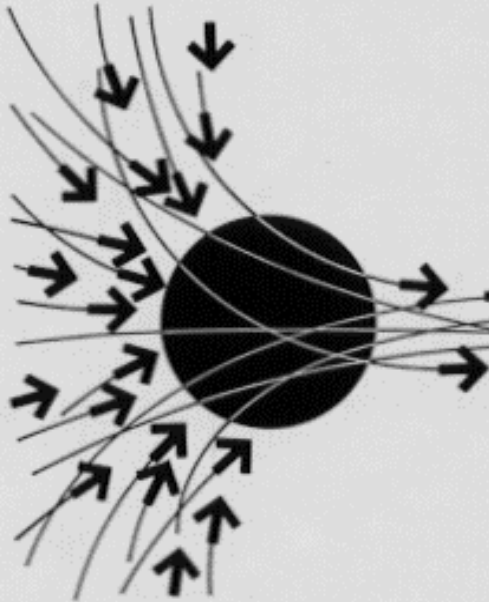
C) 20 years

D) 30 years

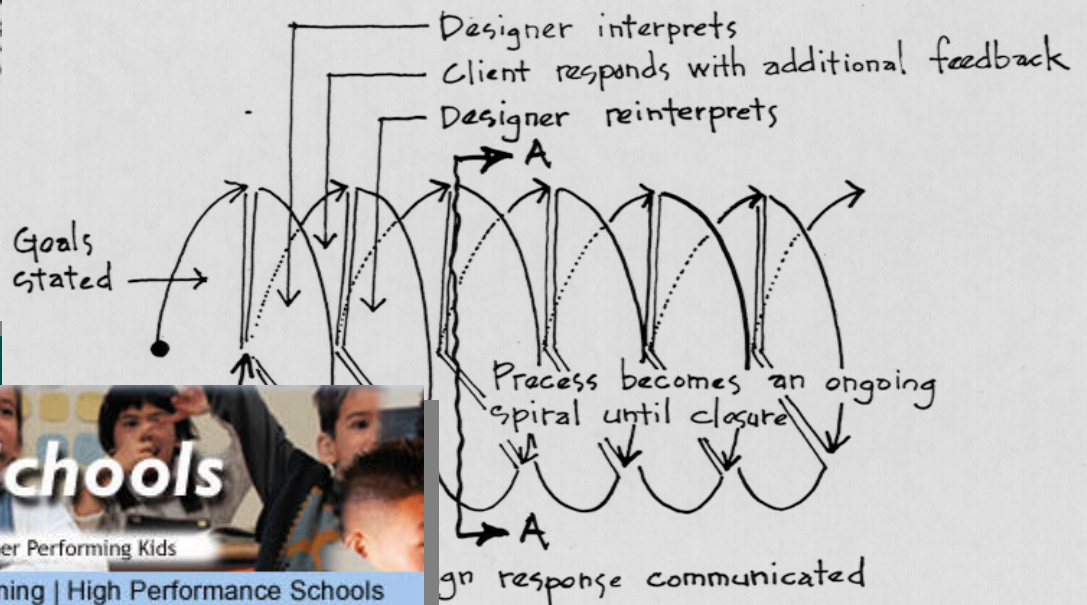
E) 50 years



## Abstract To The Essence



# Design Process



Indoor Air Quality

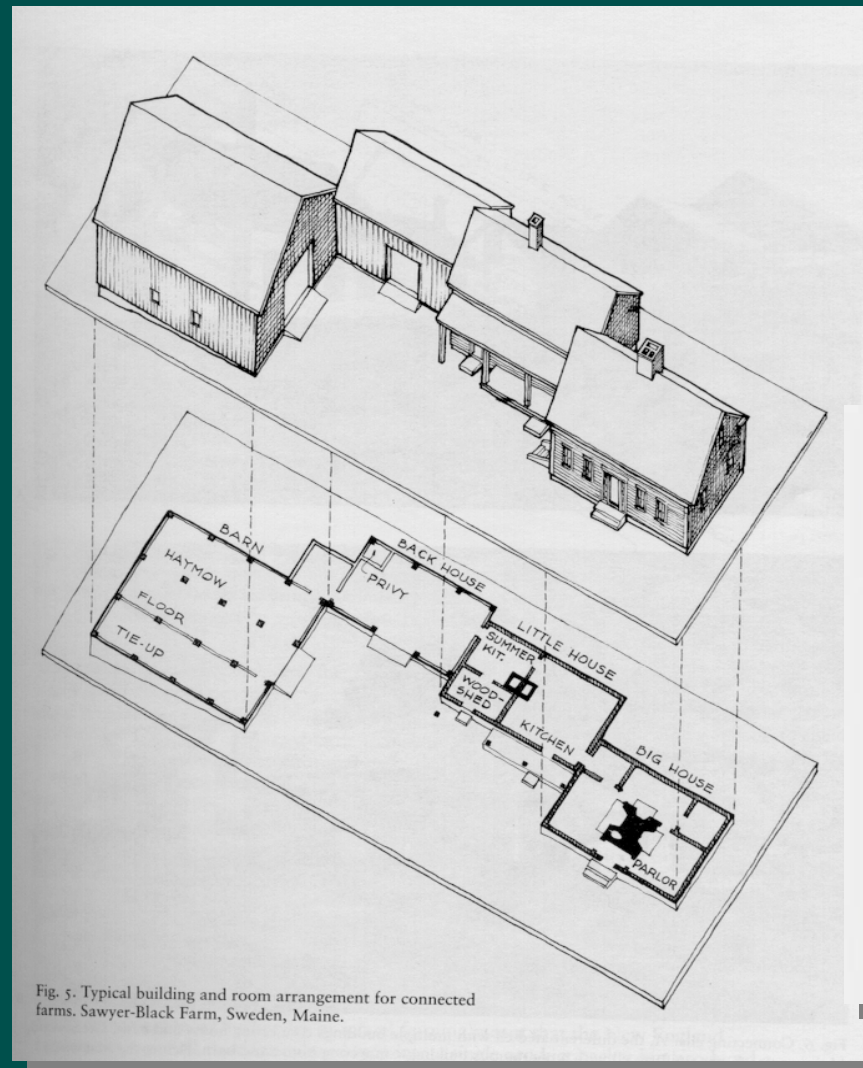
## Design Tools for Schools

Smarter Design, Construction and Renovation = Healthier and Higher Performing Kids

Hot Topics | Site Map | Links | Facilities and Learning | High Performance Schools  
Case Studies | Tool Box | EPA Programs for Schools

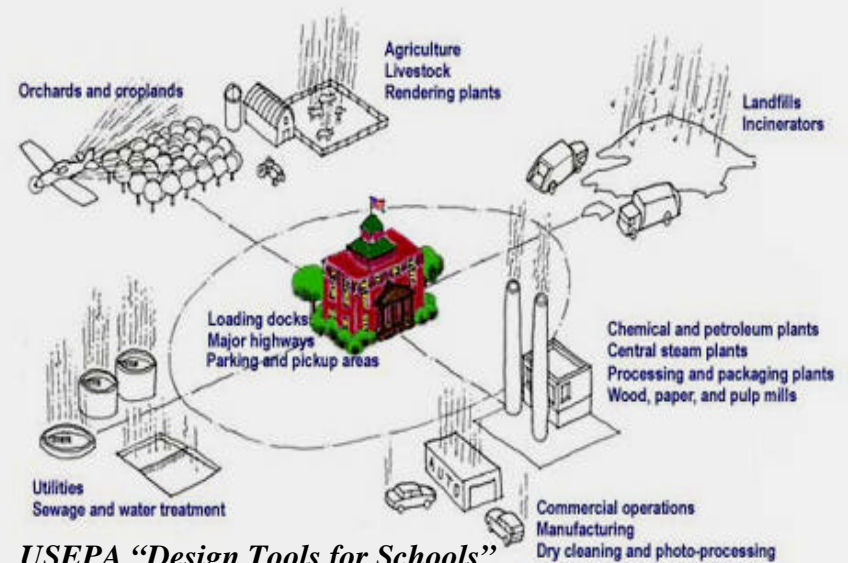
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# In the Beginning ...



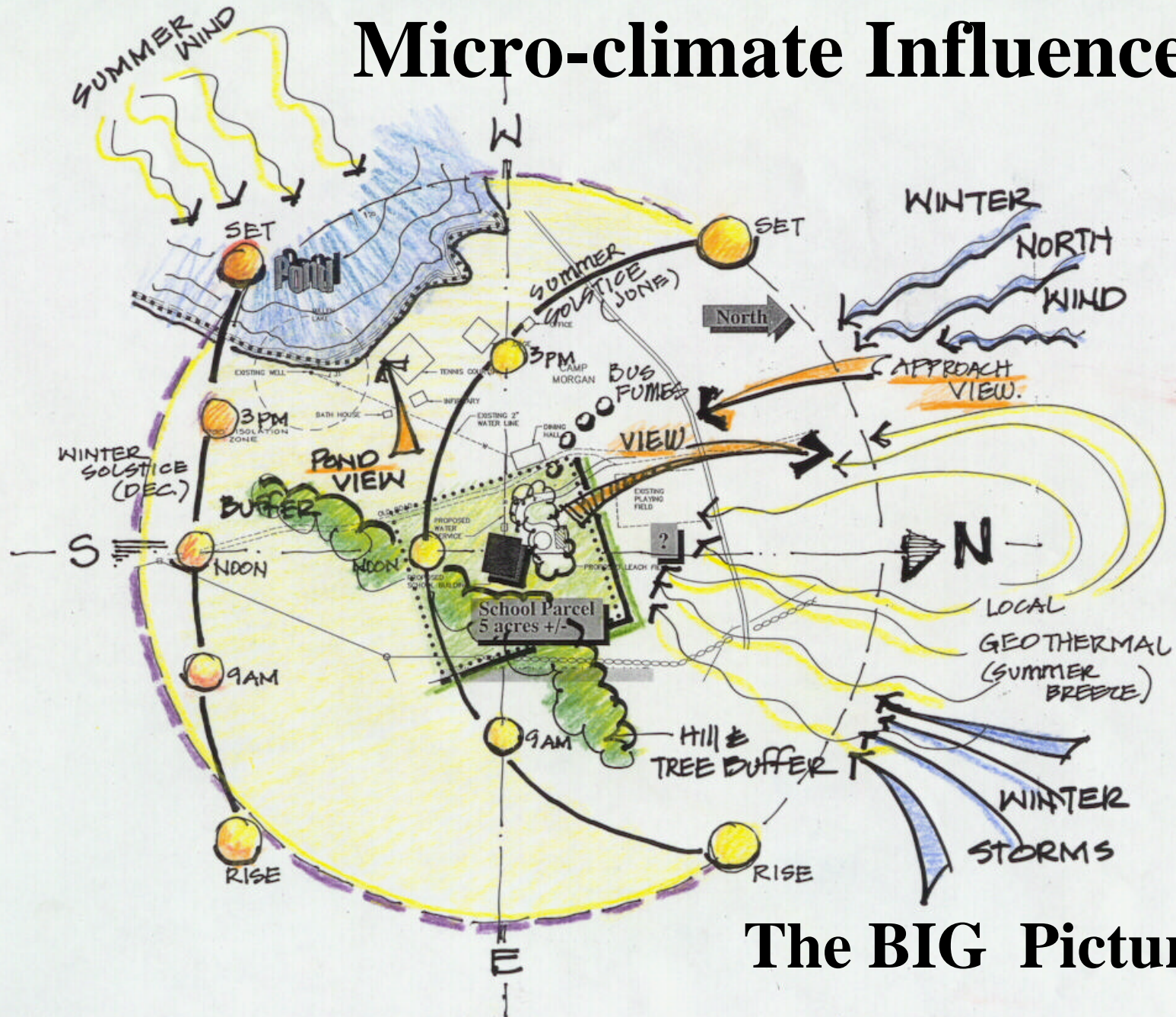
**"Big House,  
Little House,  
Back House,  
Barn"**

University Press of  
New England



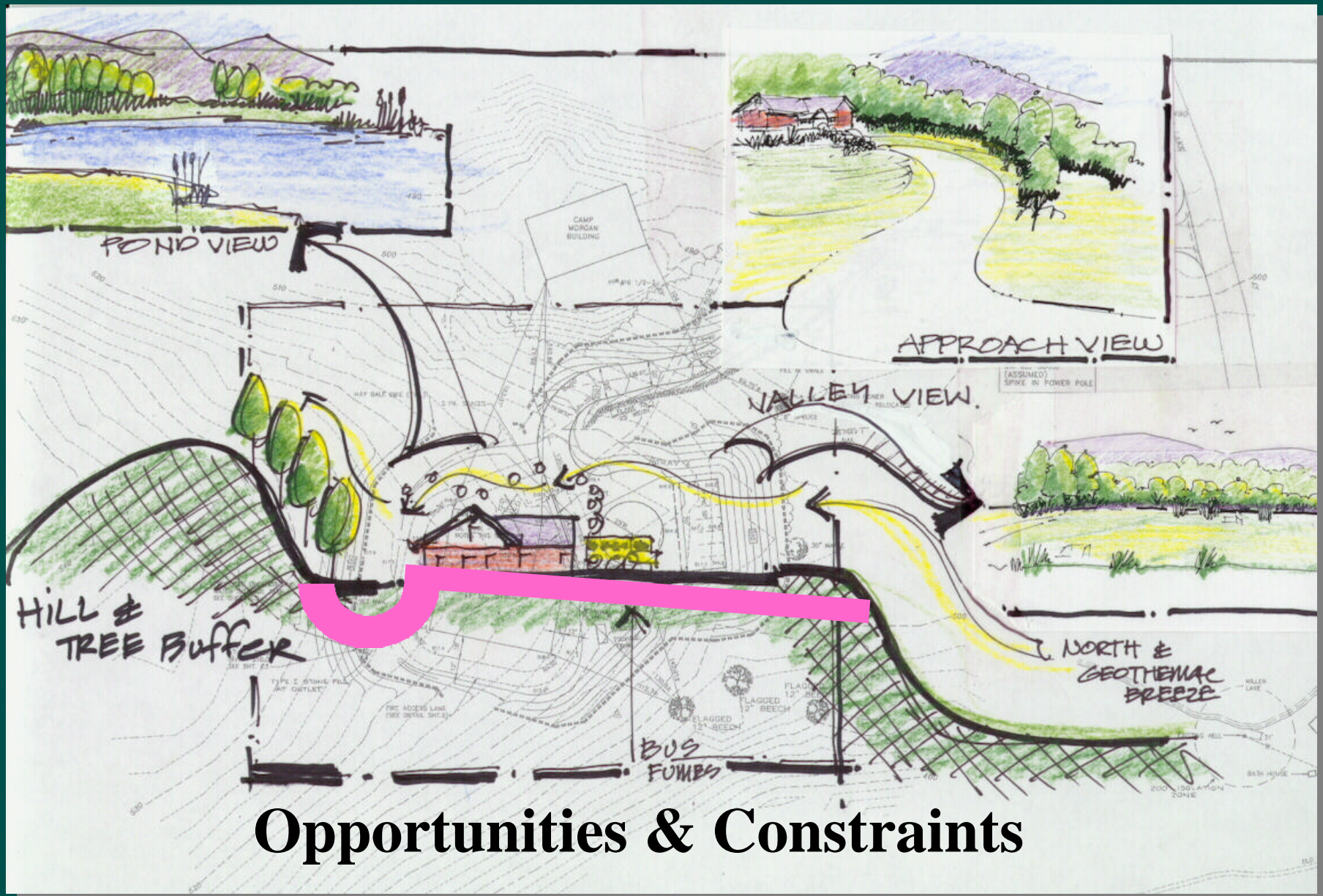


# Micro-climate Influences



The BIG Picture



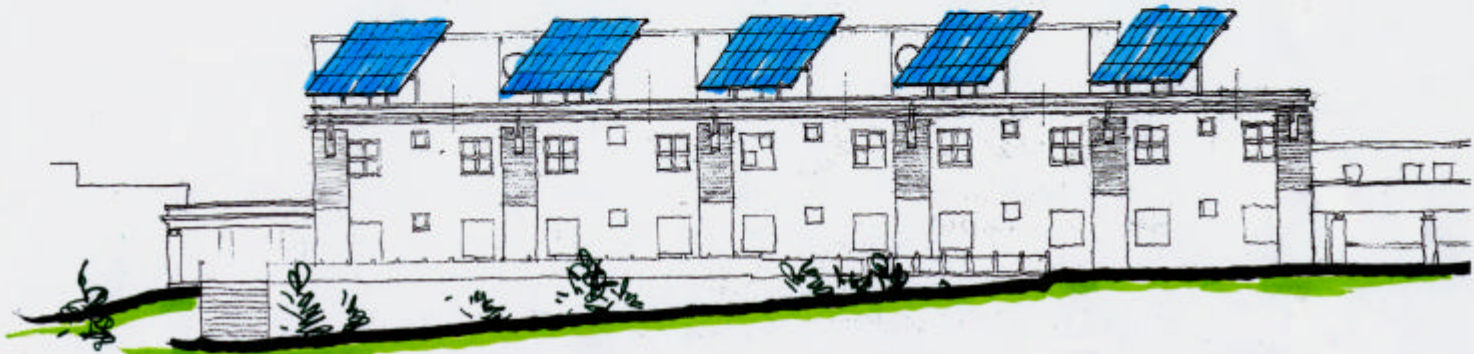


# Opportunities & Constraints

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# *“Respect for life”*

*20 KW Photovoltaic Array  
(apx. 8% of total electric use)  
Blackstone Valley Tech. Upton, MA*



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# All buildings leak



## Reality !

# Why the Concern ???

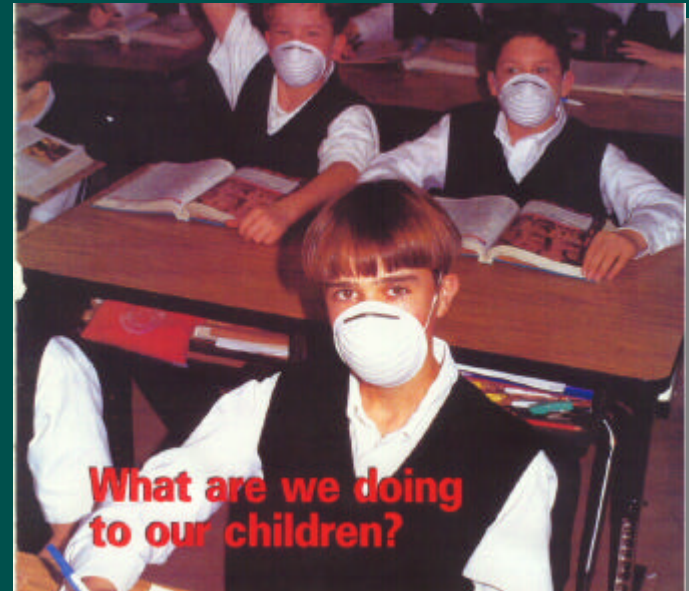
- Change in construction methodology
- Compelling circumstantial evidence

## MOLD

Lawyers ..... 'toxic tort'

Lawyers ..... 'experts'

Lawyers ..... 'media'



## Likely impact on quality of life

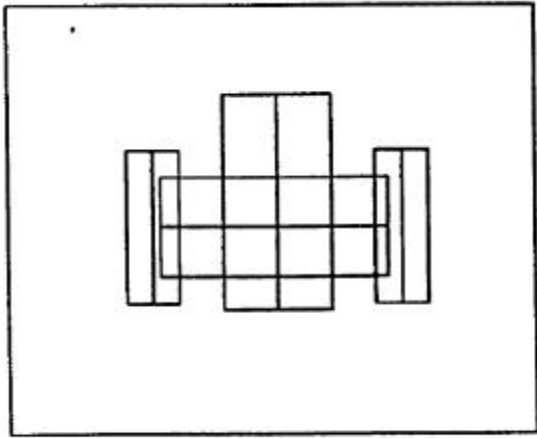
# Pitched Roofs vs. 'Flat' ?



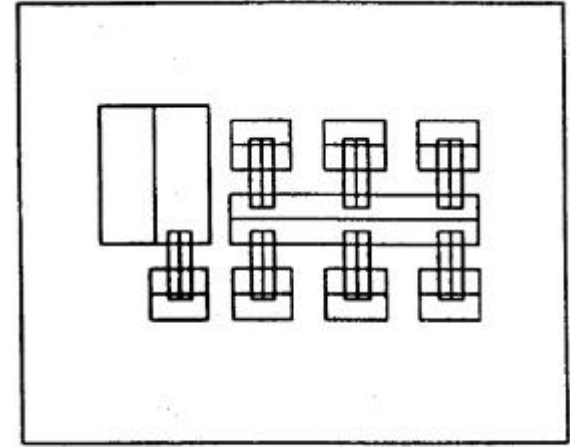
***“Drain the rain from the plane”***

*Joe Lstiburek, Building Scientist, Rule #1*



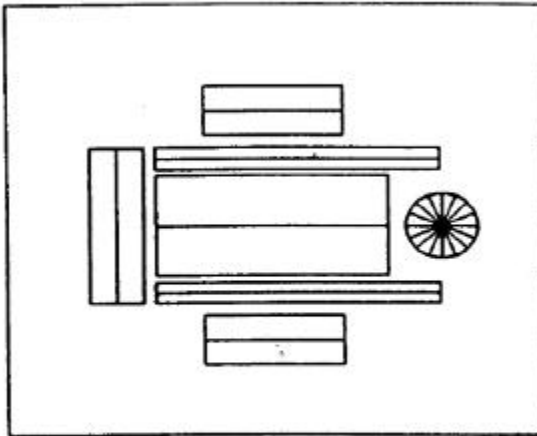


URBAN BLOCK

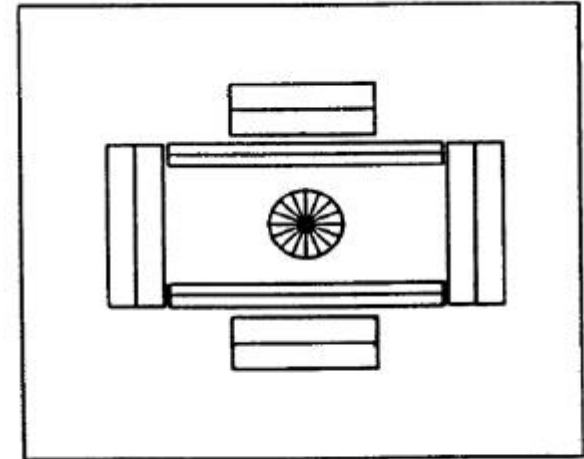


CLUSTER

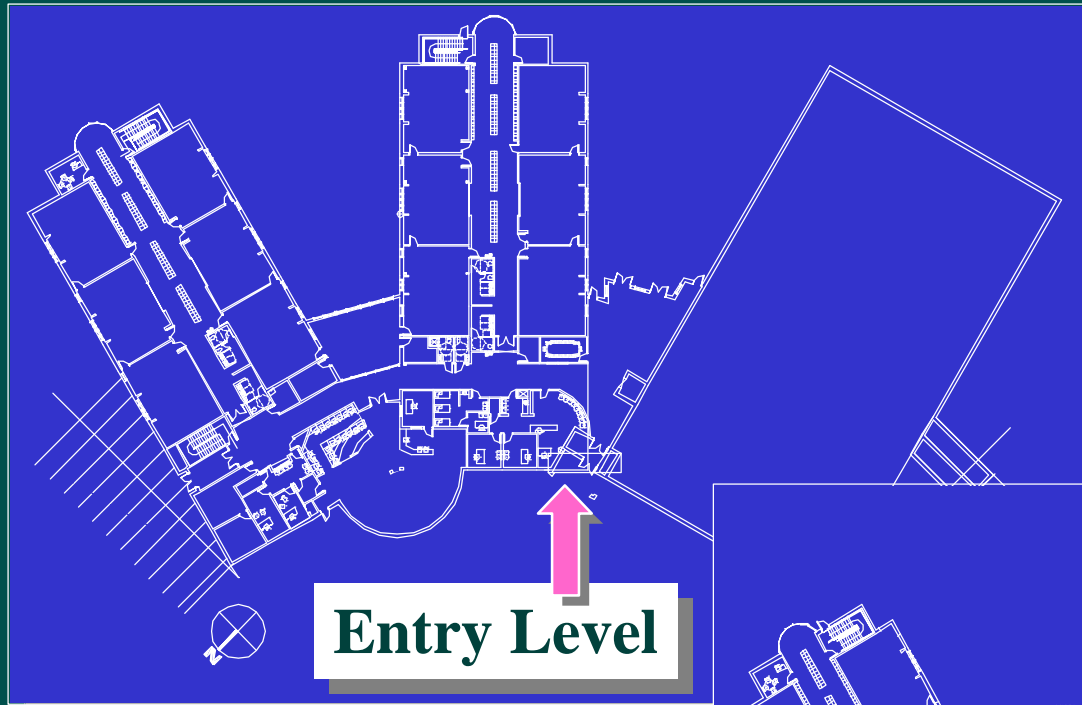
The  
Right  
Form  
???



DOUBLE CORRIDOR



COURTYARD



**Entry Level**



**Initial 'Massing' Model**

# **New HD Middle School**



**Lower Level**

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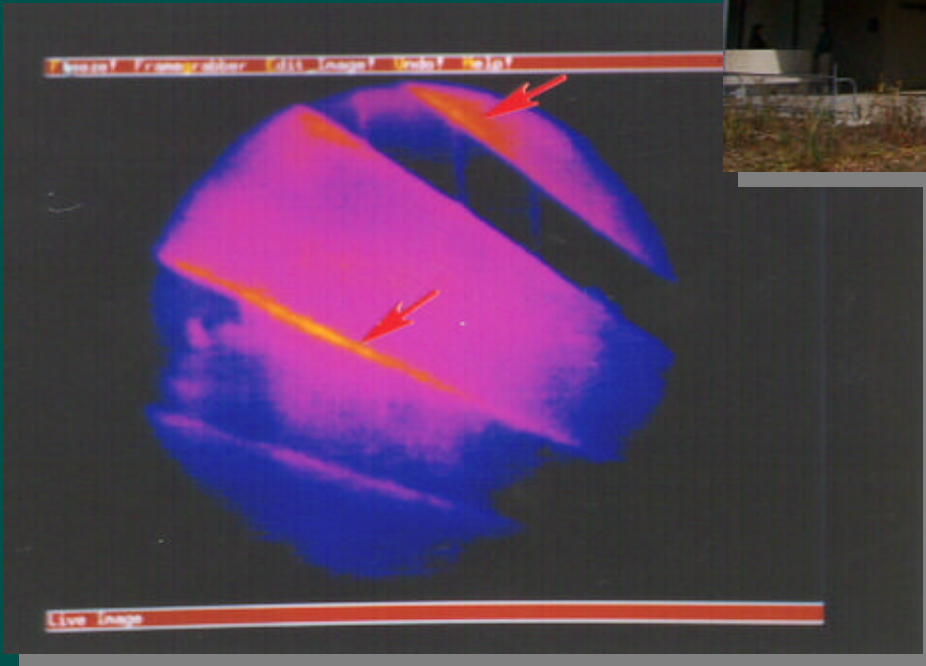


## Daylight Modeling



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# Leakage ?



*Infra-red Analysis*

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A photograph of a building's exterior. The upper portion shows a wooden roof structure with several horizontal wooden planks. Below these, there are metal brackets or hangers that support the roof. The lower portion of the image shows a green wall with a red frame. In the bottom right corner, there is a window with a dark frame that has the word 'VYCOR' repeated on it.

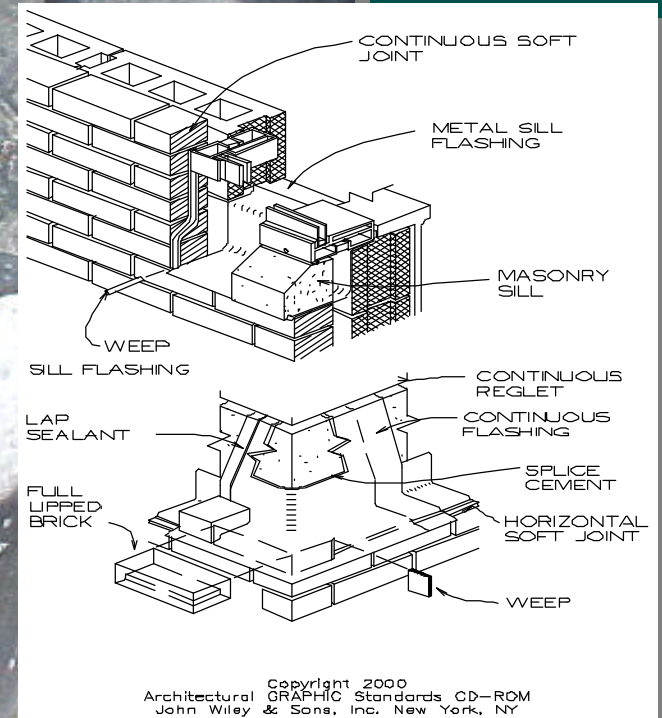
# Integrity of the 'Joints'

*"Belt, suspenders and a cummerbund"* Rule #2

# Just the way we drew it ?

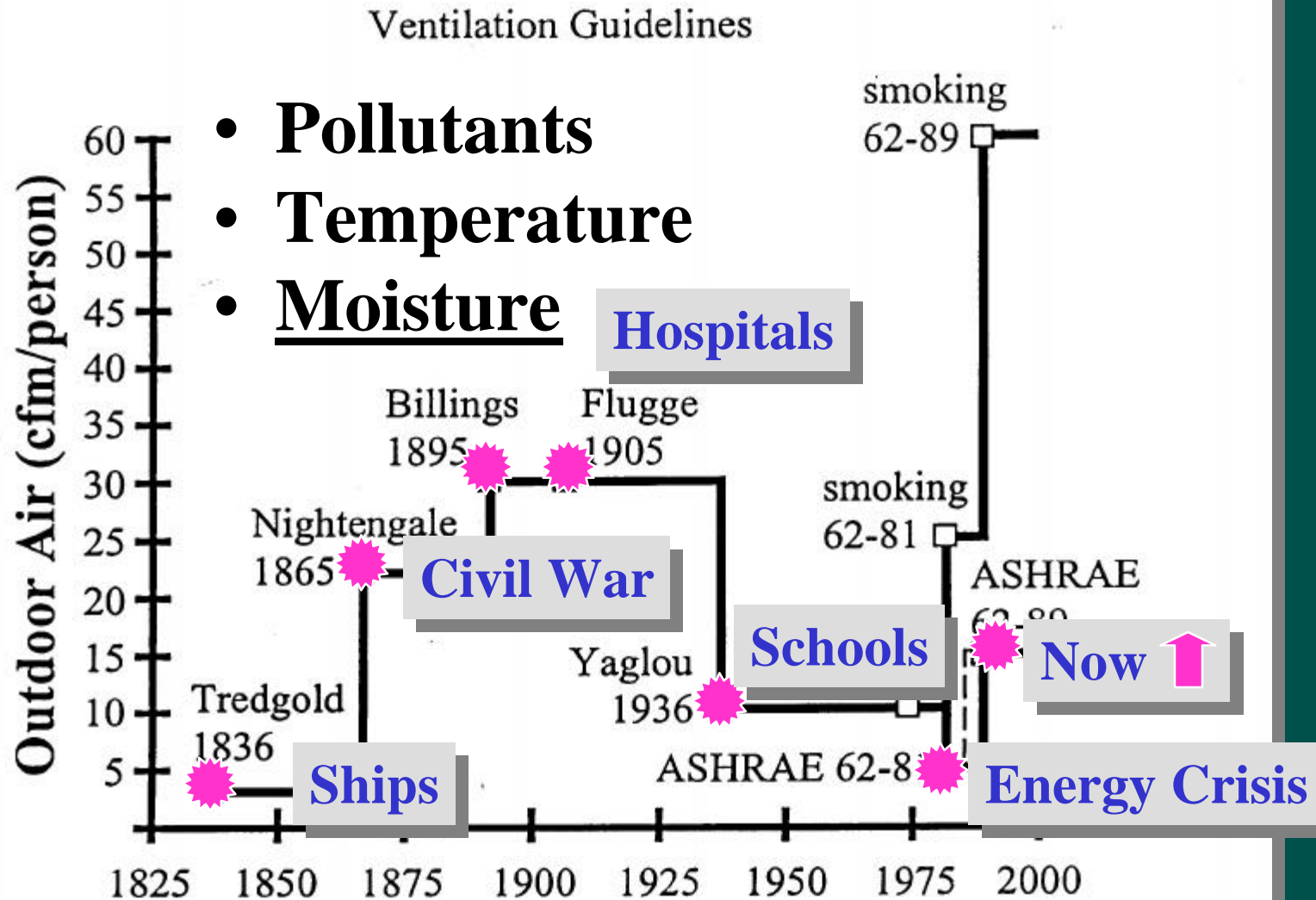


Flexible Flashing





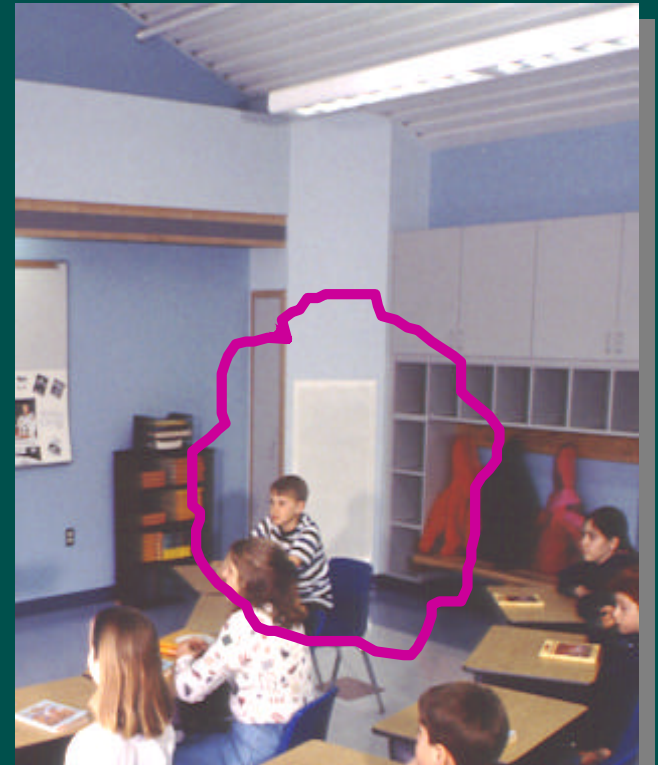
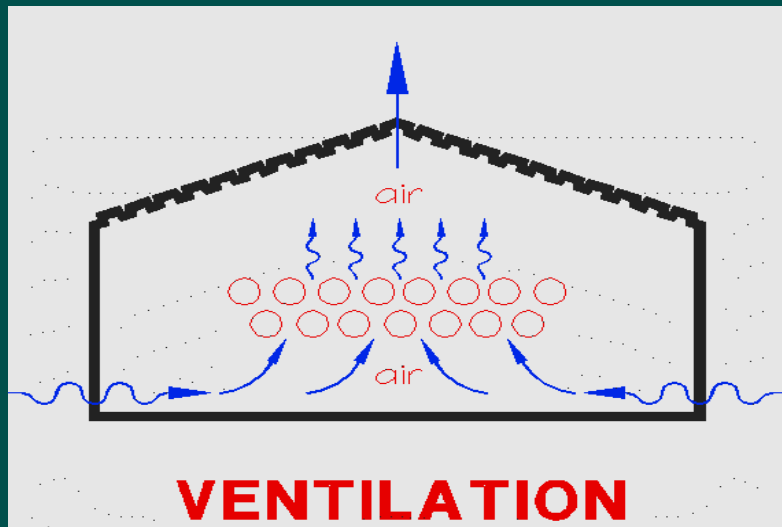
# The Evolution of IAQ



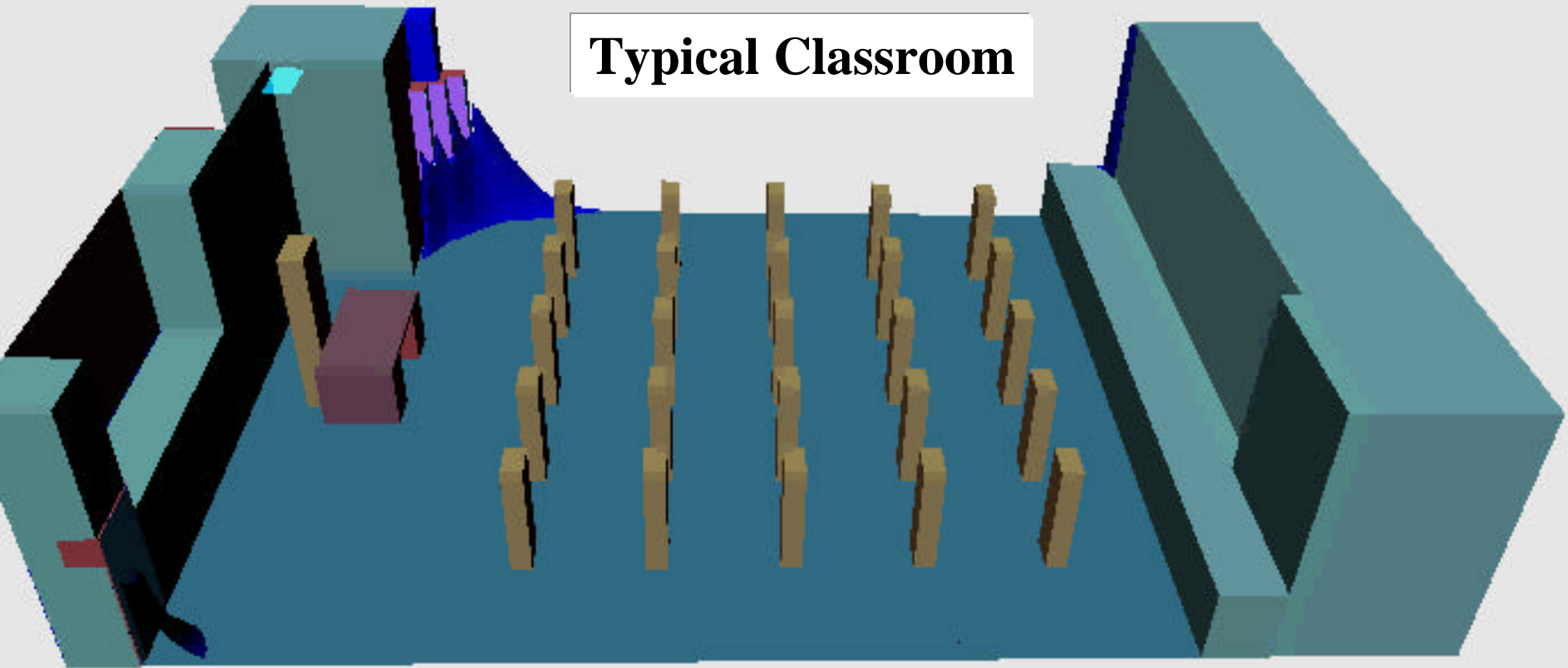


# Indoor Air Quality

- **Form Follows Function ~ Displacement Ventilation**
  - Stratify Rather Than Mix
  - 100% Outside Air With Recovered Heat and Moisture
  - Provide Local Thermal Control
  - Dehumidify @ “Swing Seasons”
  - Net Energy Savings



## Typical Classroom

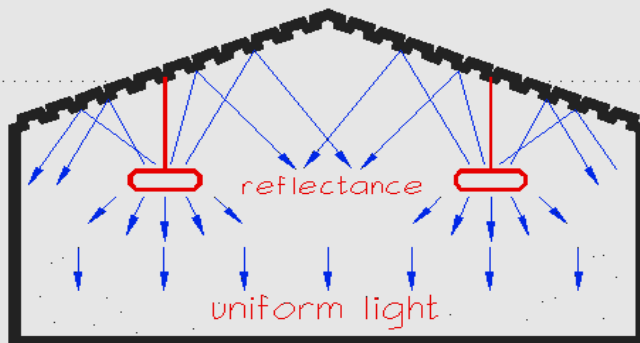


## Displacement Ventilation Concept

*Courtesy Dunham Assoc.  
Minneapolis, Minnesota*

# Lighting

- **Form Follows Function**
  - Daylighting / Indirect
  - Multiple control / efficiency
  - Security
  - Net Energy Savings



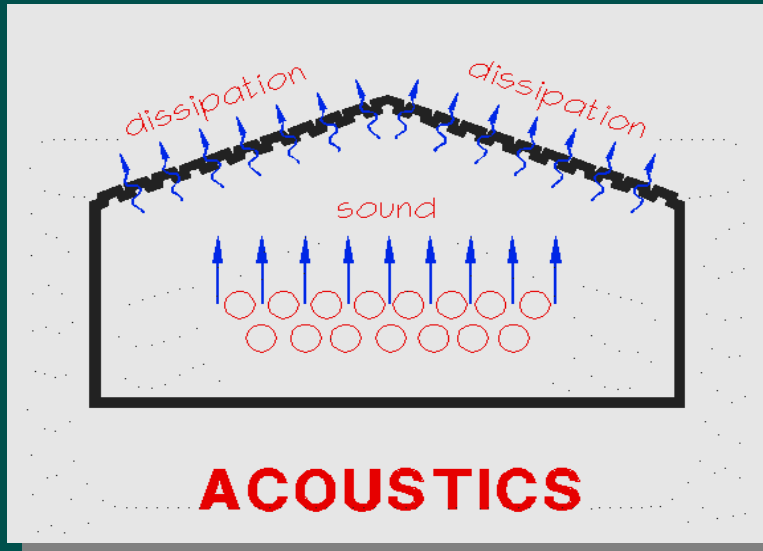
**LIGHTING**



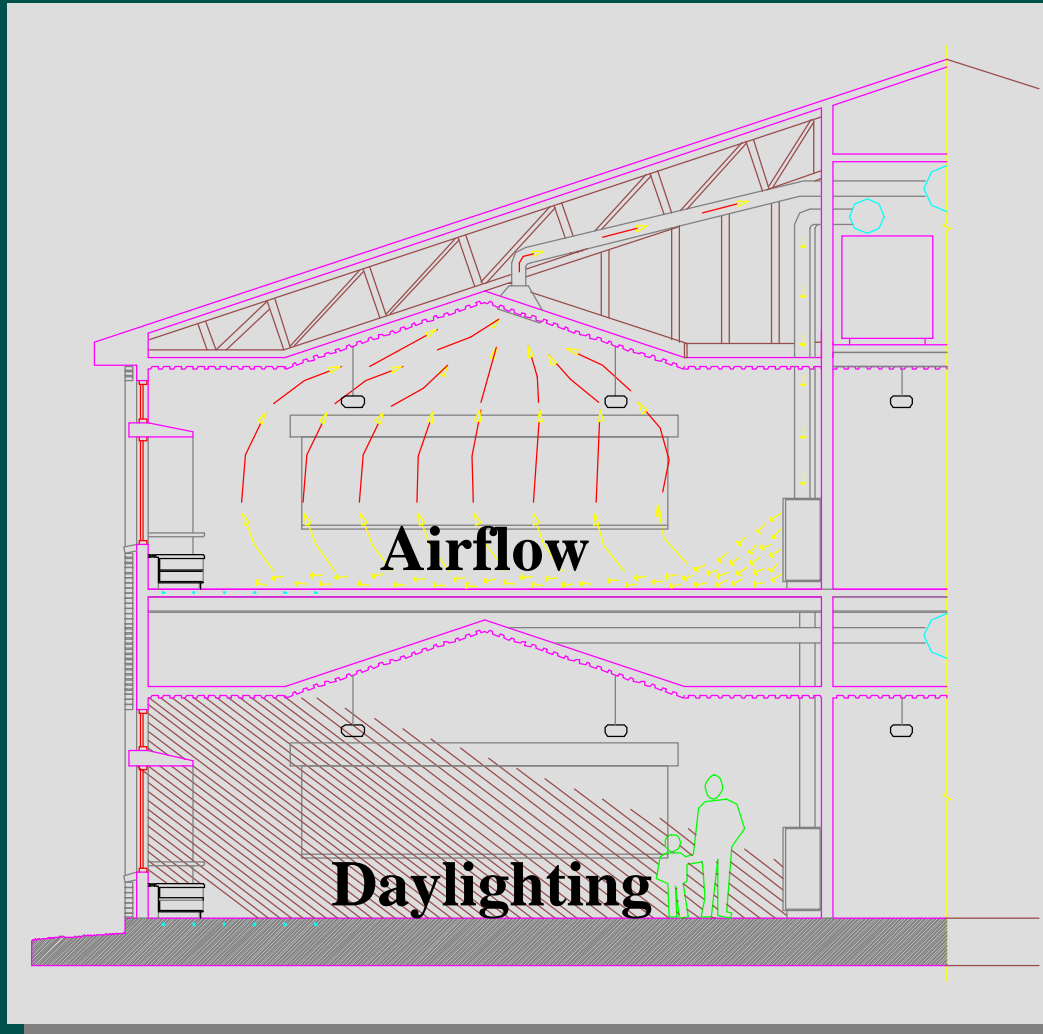
# Acoustics

- **Form Follows Function**

- Room Shape
- Ceiling Materials
- “Bright” Surfaces
- Carpet Not Necessary



# The 'Big Picture'



**Pitched *or*  
Flat Roof**

**New Construction  
*or* Renovation**

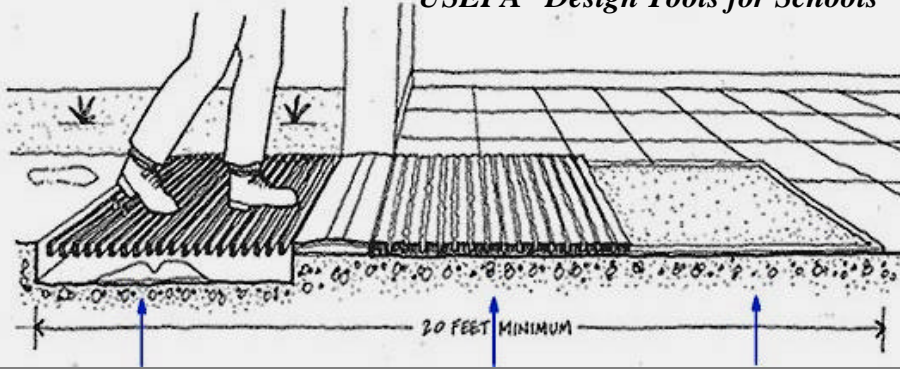
**Single *or*  
Multi-story**

**Access to Equipment**

**Adapt to Technology**



*USEPA "Design Tools for Schools"*



3 step walk-off  
matting system

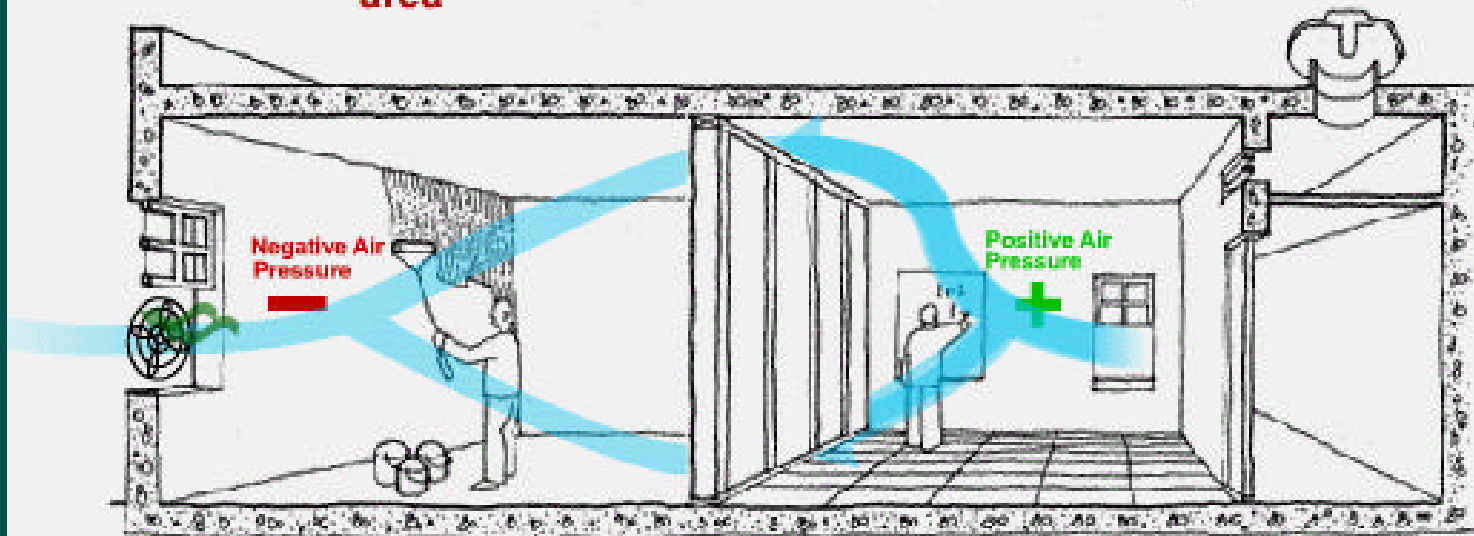
Equipment Access

*Design for*  
**Maintenance**

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# Construction Area Containment

Place an exhaust fan in work area, open a window in the occupied area, and turn off the large exhaust fan to prevent contaminated air from entering occupied area



Problem  Solution

Separate Occupants from work area

USEPA "Design Tools for Schools"



BYLLE BROWER / Monitor staff

Joel Rouillard (left) holds a carbon dioxide monitor and Sarah Polre blows on the end to bring up the temperature. Rouillard tested the air for carbon dioxide, temperature and humidity as students tried out a prototype classroom.

## Penacook

# Room with a view to the future

Students help test an innovative design

By CARRIE STURROCK

PENACOOK — A simulation classroom allowed Boscawen elementary students to glimpse the future of their education yesterday.

Sitting in a room with state-of-the-art ventilation, spacing and lighting, Kim Cheney's third-grade class listened to architects explain how the new Boscawen Elementary School was designed and what it will be like.

"You are the very first class to get a preview of what the new school building is going to be like. You guys are making history today," said Loren Belida, vice president of architecture at The H.L. Turner Group in Concord.

Last May voters approved a bond in-

use for the new elementary school, which is being constructed on a 91-acre site.

The Turner Group built the mock classroom, nicknamed "Advantage Classroom," in Penacook's old Summer Street School in order to test and study their innovative school design.

"This is very unusual. Since it's so experimental we wanted something for testing," said Vice President Dennis Melchin.

Most of the labor and materials were donated. The total cost to taxpayers is \$10,000, or 15 percent of the actual cost. Melchin said hiring an outside testing agency would have cost that much or more, minus the mock classroom.

So while students learned about indoor environments, members of the ar-

chitectural firm tested the room for temperature, humidity and carbon dioxide levels.

Throughout the morning engineer Rouillard circled the room taking readings. When his equipment began beeping loudly, a lesson ensued.

"She's breathing on my carbon dioxide monitor," said Rouillard, pointing to a student. He explained when a room lacks proper ventilation, carbon dioxide builds up and makes people sleepy. Belida said that often happens in a conventional classroom. While most schools have one ventilation system and only one thermostat, each room in the new school will have one of each.

That prospect makes Cheney happy. Currently, her downstairs classroom at Boscawen Elementary has to be kept extremely hot in order to heat the up-

See CLASSROOM — Page B-10

# Commissioning

## Does the building really perform as intended ?



# Social Dynamics *and* Psychology of Color



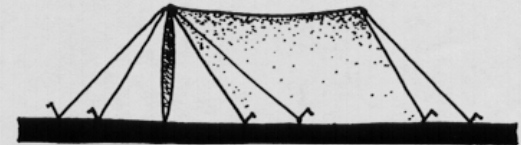
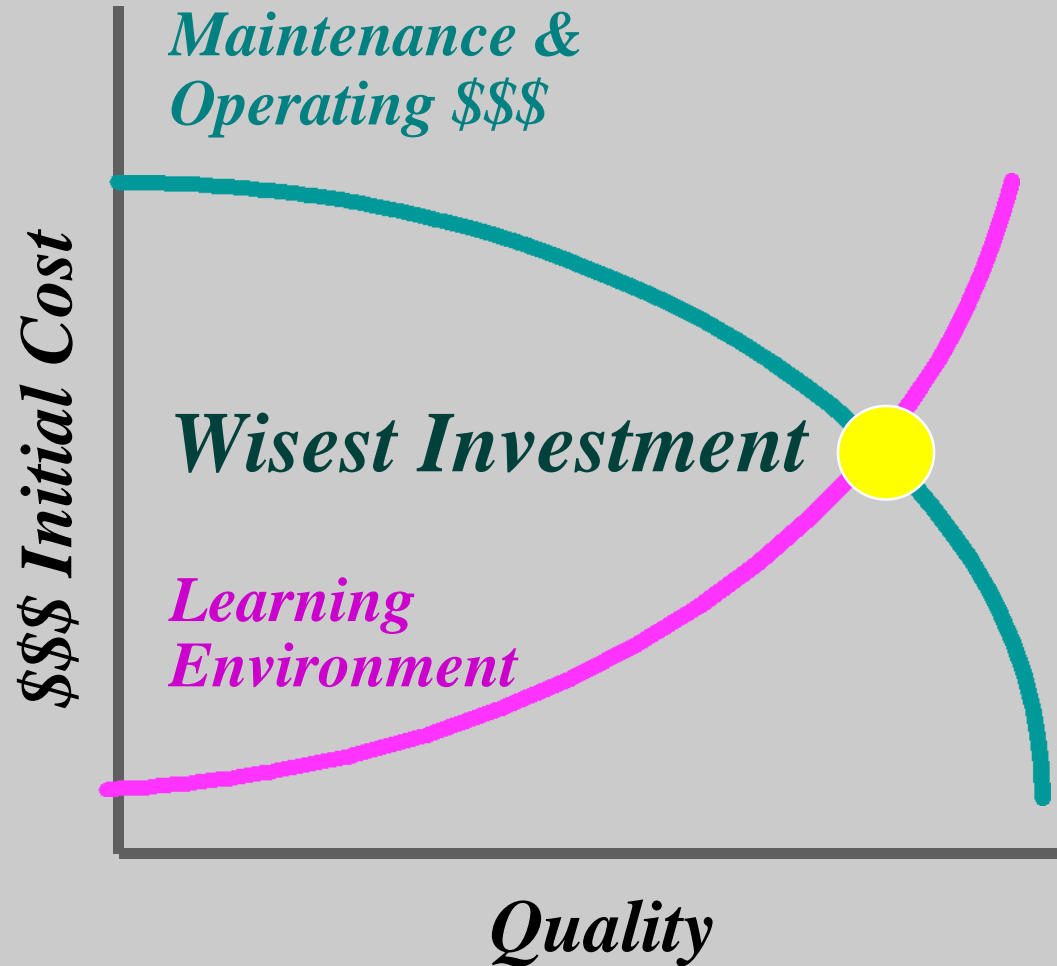
*“How do people really learn and work together ?”*

# Schools As Centers of Community

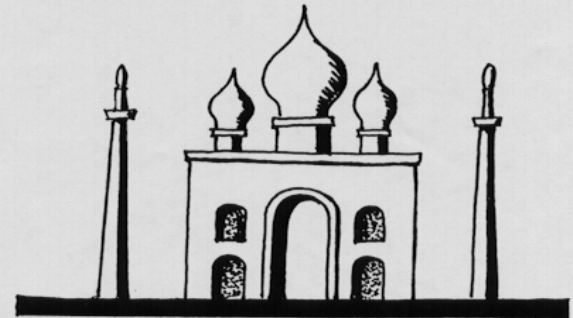


- **Development of Academic & Social Skills**
- **Flexible Design for “After Hours” Activities**

# \$ ~ The 5th Dimension



What the client  
could afford



What was designed



# Finally, a National Standard

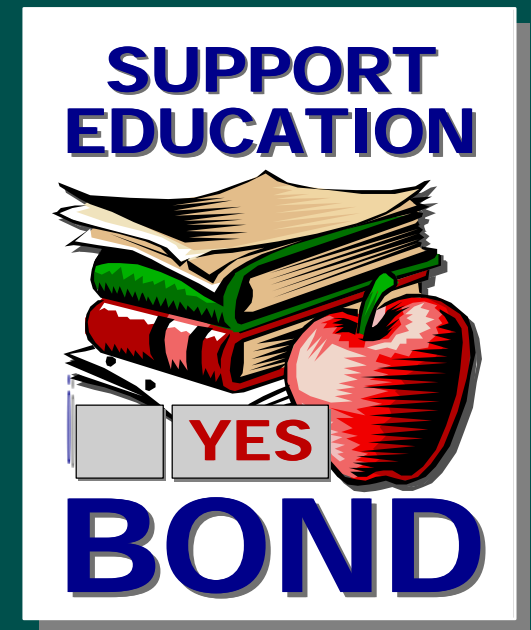


Proposed HDMS Daylighting ENERGY COST ONLY Benefit Analysis						
Component	Est. Initial Cost	Simple Payback (savings)				Comments/ Benefits
		Unit	\$/ Unit	\$/ Year	Return Years	
Current Electric Rate Average (incl. demand charges)		KWH	\$0.115			
<b>Base Plan ~ Typical Upper Floor Classroom</b>						
1) 60% Tvis insulated translucent roof windows	\$3,770	1,300	\$0.115	\$150	25	Provides min 25% of C ambient
2) 15% Tvis translucent roller shades	\$216	200	\$0.115	\$23	9	S/SW vertical glass (per room)
3) Heating/ cooling impact of skylights	\$0					Negligible either way
4) Structure to allow exposed roof deck	\$0					Already part of Classroom
5) Automatic lighting control switching	\$400	300	\$0.115	\$35	12	Insures energy savings
<b>Total per Classroom</b>	<b>\$4,386</b>	<b>1,800</b>	<b>\$0.115</b>	<b>\$207</b>	<b>21</b>	
<b>Total per Upper Level (12 Classrooms)</b>	<b>\$52,632</b>	<b>21,600</b>	<b>\$0.115</b>	<b>\$2,484</b>	<b>21</b>	
<i>Optional (Alternates):</i>						
6) Light/ sound diffusing fabric baffles	\$450	100	\$0.115	\$12	39	Improve aesthetic and sound
7) Sun "scoops" at roof windows	\$1,800	200	\$0.115	\$23	78	Minimizes Winter sun conditions
<b>Alternate Total per Classroom</b>	<b>\$2,250</b>	<b>300</b>	<b>\$0.115</b>	<b>\$35</b>	<b>65</b>	
<b>Total per Upper Level (12 Classrooms)</b>	<b>\$27,000</b>	<b>3,600</b>	<b>\$0.115</b>	<b>\$414</b>	<b>65</b>	

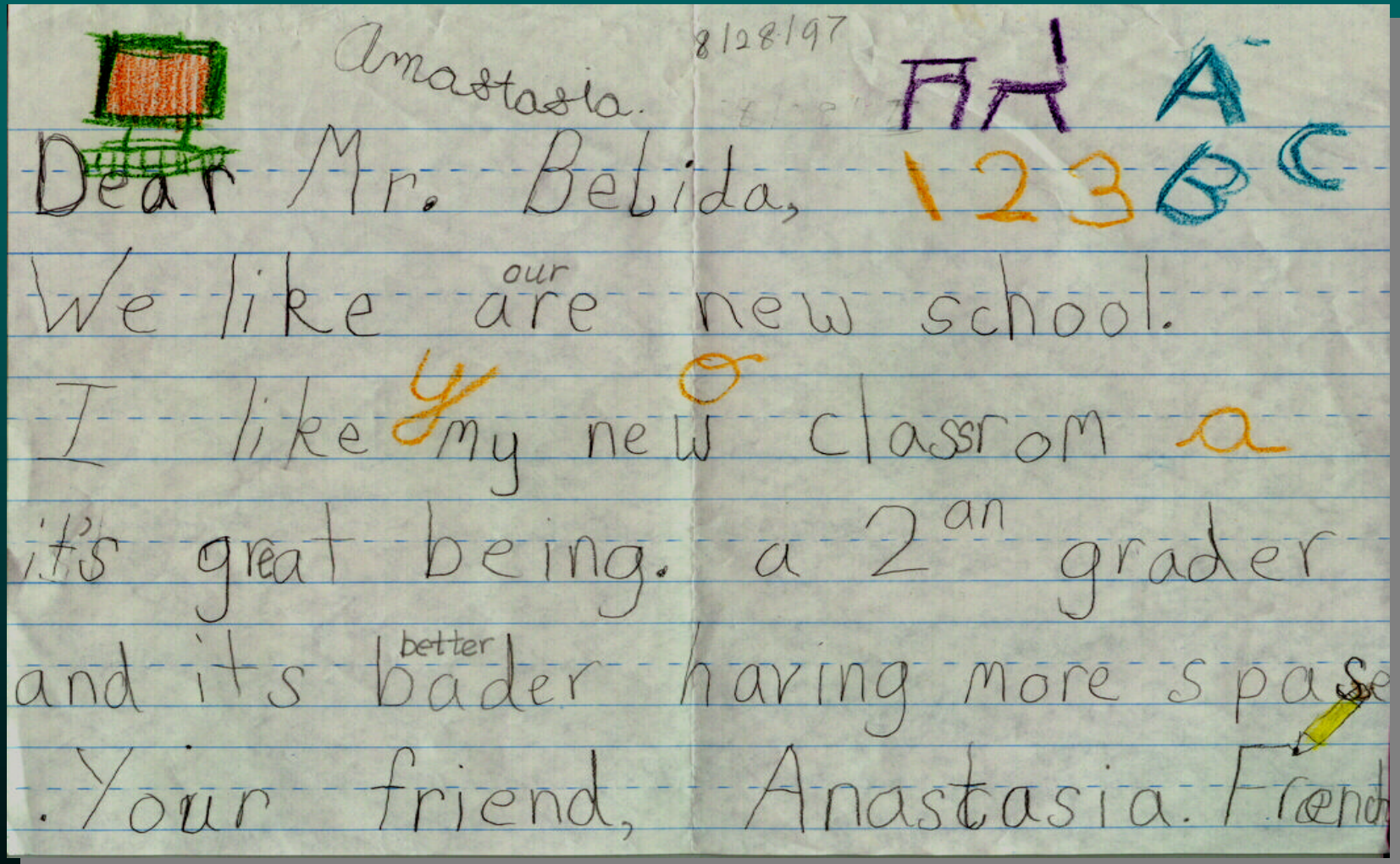
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# The Formula for *Success*

- *Concisely* define the Need;
- *Carefully* consider all of the Issues;
- *Clearly* articulate the Plan;
- *Precisely* determine the value of the Plan;
- Go to where the People are
- *Educate*



# Letter of Reference





# The Bottom Line

- *Healthy Environment =*
- *Healthy People =*
- *Higher Quality of Life*

# High Performance Schools

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The H.L. Turner Group Inc.  
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**[www.hlturner.com](http://www.hlturner.com)  
1-800-305-2289**